इंटरनेट मानक

Disclosure to Promote the Right To Information

Whereas the Parliament of India has set out to provide a practical regime of right to information for citizens to secure access to information under the control of public authorities, in order to promote transparency and accountability in the working of every public authority, and whereas the attached publication of the Bureau of Indian Standards is of particular interest to the public, particularly disadvantaged communities and those engaged in the pursuit of education and knowledge, the attached public safety standard is made available to promote the timely dissemination of this information in an accurate manner to the public.

“जानने का अधिकार, जीने का अधिकार”
Mazdoor Kisan Shakti Sangathan
“The Right to Information, The Right to Live”

“पुराने को छोड नये के तरफ”
Jawaharlal Nehru
“Step Out From the Old to the New”

IS 8032 (1976): Guide for Treatment of Distillery Effluents
[CHD 32: Environmental Protection and Waste Management]

“ज्ञान से एक नये भारत का निर्माण”
Satyanarayan Gangaram Pitroda
“Invent a New India Using Knowledge”

Act Number 22 of 2005
The Indian Parliament
RIGHT TO INFORMATION

Made Available By
Public.Resource.Org

“ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है”
Bhartṛhari—Nītiśatakam
“Knowledge is such a treasure which cannot be stolen”

BLANK PAGE

BRUTUM FULMEN

IGNORANTIA
JURIS
NON EXCUSAT

PROTECTED BY COPYRIGHT

(Reaffirmed 2003)

Indian Standard

GUIDE FOR TREATMENT OF DISTILLERY EFFLUENTS

(Fourth Reprint SEPTEMBER 1998)

UDC 628.543:663.52

© *Copyright* 1976

BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002

Gr 5

August 1976

IS : 8032 - 1976
(Reaffirmed 1993)

Indian Standard

GUIDE FOR TREATMENT OF DISTILLERY EFFLUENTS

Water Sectional Committee, CDC 26

Chairman	*Representing*
Dr T. R. Bhaskaran	Geo-Miller & Co Pvt Ltd, Calcutta
Members	
Shri A. K. Bhattacharyya	National Test House, Calcutta
Shri K. D. Das (*Alternate*)	
Shri V. M. Bhuchar	National Physical Laboratory (CSIR), New Delhi
Shri Jitendra Rai (*Alternate*)	
Shri M. S. Bidikar	Ion Exchange (India) Ltd, Bombay
Shri V. K. Rao (*Alternate*)	
Chemist and Metallurgist, Central Railway, Bombay	Railway Board (Ministry of Railways)
Assistant Research Officer (CM-II), RDSO, Lucknow (*Alternate*)	
Chief Water Analyst, King Institute, Madras	Director of Public Health, Government of Tamil Nadu, Madras
Director (Water Supply)	Planning Commission, New Delhi
Shri B. K. Dutta	The Fertilizer Corporation of India Ltd, Sindri
Shri G. S. Bhattacharyya (*Alternate*)	
Shri K. L. Ghosh	Regional Research Laboratory (CSIR), Bhubaneswar
Dr M. I. Gurbaxani	The Tata Iron and Steel Co Ltd, Jamshedpur
Prof N. Majumder	National Environmental Engineering Research Institute (CSIR), Nagpur
Shri V. K. Malik	All India Distillers' Association, New Delhi
Shri K. Kameswara Rao (*Alternate*)	
Shri K. Manivannan	Director of Industries, Government of Haryana, Chandigarh
Municipal Analyst	Municipal Corporation of Greater Bombay, Bombay
Shri S. C. Pillai	Indian Institute of Science, Bangalore
Dr I. Radhakrishnan	Ministry of Works & Housing
Shri J. D. Sheth (*Alternate*)	
Shri K. S. Ramamani	The Alkali & Chemical Corporation of India Ltd, Calcutta
Shri L. Subbaiyan (*Alternate*)	
Shri G. K. Rao	Ministry of Defence (DGI)
Shri P. N. Luthra (*Alternate*)	

(*Continued on page* 2)

© *Copyright* 1976
BUREAU OF INDIAN STANDARDS
This publication is protected under the *Indian Copyright Act* (XIV of 1957) and reproduction in whole or in part by any means except with written permission of the publisher shall be deemed to be an infringement of copyright under the said Act.

(*Continued from page* 1)

Members	*Representing*
REPRESENTATIVE	Bhabha Atomic Research Centre, Bombay
SHRI M. L. SHAH	Bombay Chamber of Commerce & Industry, Bombay
SHRI R. M. SHAH	Tata Chemicals Ltd, Bombay
SHRI R. K. GANDHI (*Alternate*)	
SHRI B. A. SHOLAPURWALA	Italab Private Ltd, Bombay
SHRI V. M. SHAH (*Alternate*)	
DR (SMT) S. M. VACHHA	Director of Health Services, Government of Maharashtra, Bombay
DR G. M. SAXENA, Director (Chem) (*Secretary*)	Director General, ISI (*Ex-officio Member*)

Waste Treatment Methods Subcommittee, CDC 26 : 1

Convener	
DR P. V. R. SUBRAHMANYAM	National Environmental Engineering Research Institute (CSIR), Nagpur
Members	
CHIEF WATER ANALYST, KING INSTITUTE, MADRAS	Director of Public Health, Government of Tamil Nadu, Madras
DR D. CHOUDHURY	Indian Chemical Manufacturers' Association, Calcutta
SHRI V. K. DIKSHIT (*Alternate*)	
SHRI R. C. P. CHOUDHURY	Engineers India Ltd, New Delhi
SHRI K. RUDRAPPA (*Alternate*)	
DIRECTOR (C. S. M. & C. R. S.)	Central Electricity Authority, New Delhi
DEPUTY DIRECTOR (C. S. M. & C. R. S.) (*Alternate*)	
SHRI B. K. DUTTA	The Fertilizer Corporation of India Ltd, Sindri
SHRI G. S. BHATTACHARYYA (*Alternate*)	
DR H. K. JOSHI	Indian Oil Corporation Ltd (Refineries & Pipelines Division), New Delhi
SHRI K. C. JAIN (*Alternate*)	
SHRI K. R. KRISHNASWAMI	Madras Fertilizers Ltd, Madras
SHRI A. K. MAJUMDAR	Geo-Miller & Co Pvt Ltd, Calcutta
SHRI U. C. MANKAD (*Alternate*)	
SHRI R. NATARAJAN	Dorr-Oliver (India) Ltd, Bombay
SHRI V. W. KALE (*Alternate*)	
SHRI B. V. ROTKAR	Maharashtra Prevention of Water Pollution Board, Bombay

Panel for Food and Fermentation Industry Wastes, CDC 26 : 1 : 2

Convener	
SHRI B. B. BHALERAO	Engineers India Ltd, New Delhi
Members	
SHRI P. H. BHATT	Kaira District Co-operative Milk Producers' Union Ltd, Anand (Gujarat State)
DR I. M. PATEL (*Alternate*)	

(*Continued on page* 17)

Indian Standard

GUIDE FOR TREATMENT OF DISTILLERY EFFLUENTS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 23 April 1976, after the draft finalized by the Water Sectional Committee had been approved by the Chemical Division Council.

0.2 There is a large number of distilleries in India. Because of distilleries being located, generally in close proximity to sugar mills, in rural areas where there are no large water courses for effective disposal of the effluents by dilution, severe pollution of small rivers and foul smell in the vicinity of distilleries are commonly experienced. The distillery industry, public health officials and other regulatory agencies recognize the problem and are anxious for abatement of pollution and nuisance created by these effluents.

0.3 Considerable work has been done in this country and abroad on proper treatment and disposal of these effluents and information and data on the subject are now available. A list of relevant references is given in Appendix A for information. These data and information have formed the basis for the preparation of this standard. While realizing that any effluent treatment process has the inherent scope for being further improved, the Committee responsible for the preparation of this standard has given careful consideration to the feasibility of the methods available in literature and has been of the view that effective measures can now be taken by distilleries for abatement of pollution occurring in areas where they are located. It is hoped that distilleries, public health authorities and other agencies concerned with water pollution control in different parts of the country will find this standard useful.

0.4 In spite of the distillery operations having been standardized and the distilleries practising them fairly uniformly, the volume of effluent and its pollutional load vary considerably from one distillery to another for the same capacity. These variations are due to various causes, principal among which are housekeeping, condition of plant and machinery, mode of their operation, and water use. In view of this, the committee has refrained from incorporating in this standard cost figures of a treatment plant based on any particular process. It is intended that each distillery will select the treatment process best suited to its local conditions.

0.5 The object of this standard is to compile information on methods of treatment of distillery effluents and to make definite recommendations for their treatment in this country. The standard does not seek to provide detailed information on the working of a distillery or on the designing and operation of the effluent treatment plant. Further, the methods recommended for adoption have been selected taking into consideration the practicability of their adoption by the industry. When better and more economic methods of treatment become available, revision of this standard will be taken up.

0.6 It is recommended that distilleries located near the sea may preferably discharge their effluents into the marine coastal area rather than into inland surface water. The extent of pollution of marine coastal areas permitted by discharge of effluents is laid down in IS : 7967-1976*.

0.7 The extent of pollution of inland surface waters permitted by discharge of effluents is laid down in IS : 2296-1974†. The following Indian Standards lay down tolerance limits for industrial effluents:

IS : 2490 (Part I)-1974 Tolerance limits for industrial effluents discharged into inland surface waters: Part I General limits (*first revision*)

IS : 2490 (Part II)-1974 Tolerance limits for industrial effluents discharged into inland surface waters: Part II Distillery industry (*first revision*)

IS : 3306-1974 Tolerance limits for industrial effluents discharged into public sewers (*first revision*)

IS: 3307-1965 Tolerance limits for industrial effluents discharged on land for irrigation purposes

IS : 7968-1976 Tolerance limits for industrial effluents discharged into marine coastal areas

0.8 Methods of sampling and test for industrial effluents are covered in various parts of IS : 2488‡.

1. SCOPE

1.1 This standard covers methods of treatment and disposal of effluents of distilleries. It is a compilation of available data and information on sources, nature, volumes and pollutional effects of the effluents, ways of waste prevention and methods of their treatment and disposal.

---

*Criteria for controlling pollution of marine coastal areas.

†Tolerance limits for inland surface waters subject to pollution (*first revision*).

‡Methods of sampling and test for industrial effluents:

Part I-1966	Part IV-1974
Part II-1968	Part V-1976
Part III-1968	

1.1.1 Distilleries manufacture alcohol from various natural products. Distilleries in India are primarily engaged in the production of alcoholic beverages from grains and industrial alcohol from molasses. Waste treatment and disposal problems of breweries and factories producing yeast from molasses will be dealt with in other Indian Standards.

2. DESCRIPTION OF PROCESSES INVOLVED IN DISTILLERIES

2.1 In making whisky and other alcoholic beverages from malt and molasses, the conditions are so adjusted as to result in maximum yield of alcohol. Different kinds of raw materials, such as barley, wheat, maize, *mahua* flowers, etc, are used for making the wort. Wort is then distilled. The residues from the distillation process together with the wastes produced in preparing the wort constitute the waste waters discharged from the distilleries.

2.2 The process of manufacture of alcohol from molasses is mainly used for the production of industrial alcohol in this country. The molasses are diluted with water. The molasses are then allowed to ferment under controlled conditions of temperature and *p*H. Nutrient supplements in the form of ammonium sulphate or urea are also added. Yeast sludge containing about 30 percent solids settles down in the fermentation vats and constitutes a major source of waste. The liquid is then distilled for recovery of alcohol. The residues which are known as ‘ spent wash ’ which is hot when discharged, constitute the important source of waste water from the molasses distillery. Other waste waters originate from the washing of the floors, presses, fermentation vats and other equipment.

3. SOURCES, VOLUME AND CHARACTER OF EFFLUENTS

3.1 In the production of alcohol from molasses, 3 to 10 kg of molasses are used for producing 1 litre of alcohol; and for each litre of alcohol about 10 to 15 litres of spent wash is produced. The distillery spent wash is hot, highly coloured and acidic, apart from containing high percentage of dissolved inorganic and organic matter, the latter being particularly responsible for high biochemical oxygen demand (BOD) and the polluting nature of the waste. Spent wash of Indian distilleries also contains higher amount of potash as compared to those from distilleries abroad. Table 1 shows the average characteristics of the spent wash of Indian distilleries.

3.2 The yeast sludge in fermentation vats is another source of strong waste in a distillery, but this waste and other wash waters are discharged along with the dealcoholized spent wash. The cooling and condenser waters are generally six times the volume of the spent wash and contain little contamination since they are used in surface condensers.

3.3 Total waste volume is 60 to 100 litres per litre of alcohol produced.

TABLE 1 CHARACTERISTICS OF SPENT WASH OF MOLASSES DISTILLERIES IN INDIA

(*Clause* 3.1)

(All values except *p*H and BOD are expressed as percent.)

Sl No.	Characteristic	From Literature[1]	Data from 15 Factories Surveyed by NEERI[2]
(1)	(2)	(3)	(4)
i)	*p*H value	4·5 to 5·0	3·0 to 5·4
ii)	Total solids	8 to 9	0·15 to 10·4
iii)	Volatile solids	5·3 to 6·0	0·11 to 7·5
iv)	Ash	2·7 to 3·0	0·02 to 2·2
v)	Calcium (as CaO)	0·26 to 0·4	—
vi)	Potash (as K_2O) (*see* Note)	0·6 to 1·5	0·03 to 0·72 (7 factories)
vii)	Sodium salts (as Na_2O)	0·15 to 0·2	—
viii)	Iron, etc (as hydroxides)	0·01 to 0·03	—
ix)	Acid insolubles	0·1 to 0·15	—
x)	BOD (5 days at 20°C), mg/l	30 000 to 70 000	10 000 to 73 000
xi)	Phosphorus (as P)	—	0·1 to 1·0
xii)	Nitrogen (as N)	—	0·01 to 1·5

Note — In general potash content ranges between 7 to 15 percent of the total solids.

4. POLLUTIONAL EFFECTS

4.1 The pollutional effects of distillery wastes are due to high biochemical oxygen demand and colour. Stagnation of the effluent on land results in obnoxious conditions in the region. If the soil is porous the effluents may also affect ground water quality. Discharge of untreated distillery effluents into water courses results in rapid depletion of oxygen content of water, making the environment unfit for fish life. The effluent may also impart colour and odour to the water and result in unsightly conditions in the water course.

5. METHODS OF TREATMENT, UTILIZATION AND DISPOSAL

5.1 Industrial Utilization

5.1.1 Spent wash from a distillery contains high percentage of organic and inorganic matter, both in suspended and dissolved form. Removal and utilization of these materials from the waste have become an integral part of the waste treatment programme by this industry abroad since many years. Complete recovery of grains in the form of distillers' dried grains and distillers' dried solubles as cattle feed, has become an accepted practice abroad. Under this method of recovery the slops are passed through screens to remove the suspended matter (grains), which are then treated by pressing to increase the concentration of solid matter to about 30 percent. The liquor is concentrated in multiple effect evaporators and a thick syrup is obtained, which is then mixed with the pressed grain and the mixture is dried in driers. Recovery of by-products from grain distilleries and using them as cattle feed, solves the disposal problem of the distilleries and brings in revenue.

5.1.1.1 In a process developed in USA by Hiram Walker and Sons Inc, the grains are removed from the slops and treated in presses, the liquor is then concentrated to 45 to 50 percent solids. The pressed grains and the concentrated liquor are dried and are known as distillers' dried grains and distillers' dried solubles. They have a special value in dairy and poultry rations because of their rich protein, fat and vitamin content, and lactation factors [3,4,5].

5.1.2 Mixed feeds are also manufactured, particularly in USA, from spent wash of molasses distilleries by a process of concentration. One such semi-solid product[6] is marketed in USA with 45 percent solid content.

5.1.3 Boruff[6] and others have reported on the commercial production of riboflavin and other B vitamins and an antibiotic from stillage.

5.1.4 Some distillers in India are practising recovery of dried yeast powder of pharmaceutical quality from spent wash-yeast sludge mixture. A plant producing 600 tonnes per year yeast powder is reported to be working.

5.1.5 Bhaskaran[7] reported that the sludge resulting from aeration of distillery waste contained high concentration of vitamin B_{12} of the order of 800μg/kg of dry sludge, and this can be used as a supplementary animal or poultry feed.

5.1.6 *Potash Recovery*

5.1.6.1 Recovery of potash by concentration and incineration of molasses spent wash was practised abroad during the First World War[8] and up to late thirties. Jackson[9] reported recovery of potash from beet molasses. In 1945, Reich[10] described a process wherein by dilution, acidification and heating of molasses prior to fermentation, about 88 percent calcium salts could be precipitated as calcium sulphate. Activated carbon and salts of potassium and sodium could be obtained by suitable treatment of spent wash.

5.1.6.2 By adopting the process developed by Whitaker[11], ammonia and potash could be recovered from dilute spent wash.

5.1.6.3 Chakrabarty[1,12] and Bhaskaran[12] carried out a pilot plant study to recover potassium salts from spent wash of a molasses distillery in India. In this process, raw spent wash was neutralized with lime and evaporated to about 75 percent solids in a forced circulation evaporator under vacuum by duplicating a multiple-effect system. Thick liquor was burnt in an incinerator where the spent wash was converted to a substance called 'spent wash coke', which burnt itself under the grates of the incinerator and turned into ash, thereby supplying necessary heat required for the incoming thick liquor. The process was continuous and self-supporting. The ash was collected and leached with water, by which all the soluble potassium and sodium salts dissolved in it, leaving behind iron, silica, calcium and other impurities in the residue. The solution was alkaline due to the presence of potassium carbonate, which was filtered and neutralized with sulphuric acid and further concentrated in the evaporator. Potassium salts in the form of chloride and sulphate were crystallized from the concentrated solution in the crystallizer.

It has been reported by these workers that for full scale operation, prior neutralization of spent wash would not be necessary since the evaporator may be made of stainless steel or copper, or it may be copper lined. They have also recommended the use of a forced circulation type quadruple-effect evaporator instead of a natural circulation type evaporator, to minimize foaming and scale formation due to the presence of calcium sulphate in the spent wash, and economize on steam. The concentration of the spent wash should also be limited to 60 percent in the evaporator. The final product obtained from the pilot plant had the composition shown in Table 2. A flow sheet for recovery of potassium salts from distillery waste is shown in Fig. 1. It has been claimed that a distillery in India producing on an average about 320 kl of spent wash per day could recover about 3·85 tonnes of potash (K_2O), or about 5·7 tonnes of potassium sulphate and 1·27 tonnes of potassium chloride per day.

TABLE 2 COMPOSITION OF EXTRACTED POTASSIUM SALTS FROM SPENT WASH

	Percent
Potassium chloride (KCl)	16·5
Potassium sulphate (K_2SO_4)	73·5
Sodium salts	5·0
Moisture	5·0

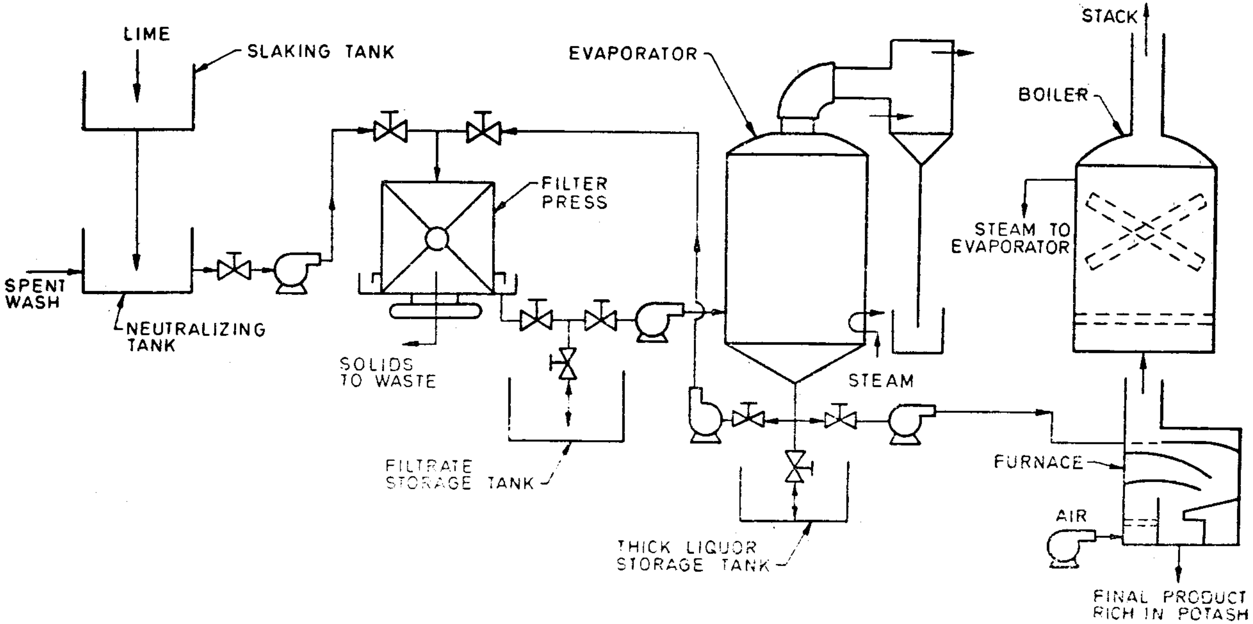


Fig. 1 Flow Sheet of Pilot Plant for Recovery of Potash from Distillery Spent Wash

5.1.7 In a semi-continuous study carried out by Ghosh *et al*[13] on sulphide fermentation of twenty times diluted distillery liquor plus 0·1 percent urea and 5 percent gypsum powder, the yield of sulphide was observed to be 44·7 percent and 32·6 percent of the mass of total carbon present in the charge at retention periods of 12 days and 6 days respectively. On the basis of the study, they proposed a scheme in which treatment of 5 000 litres of the waste should produce 75 000 litres of total gas composed of 45 000 litres of methane, 6 000 litres of hydrogen and 22 500 litres of carbon dioxide; 25·5 kg of elemental sulphur and 21 kg of potash could also be recovered.

5.1.8 A process has been patented by Rastogi and Agarwal[14] for preparation of a palatable protein digest from distillery sludge. The process consists of washing the sludge free from molasses and other soluble organic and inorganic impurities, partial autolysis by pressure cooking, enzymatic digestion and concentration, and drying under vacuum. The preparation thus obtained was a brown powder readily soluble in water. The authors claimed that it might be used effectively as a protein supplement in protein deficiency diseases.

5.2 Agricultural Utilization

5.2.1 *Irrigation on Land* — In India several distilleries located in villages and small towns, use their spent wash for irrigation after dilution with water. But the dilution and land requirement for the purpose are high. In addition, this method has the disadvantage of contaminating irrigation channels, ground water, and creating foul smell when an overdose of the waste was used, and an application of these wastes to agricultural land had, therefore, to be restricted.

5.2.2 The quality of wastes that can be applied on land for irrigation purposes has been laid down in IS : 3307-1965* and the degree of dilution required for distillery wastes prior to application on land can be worked out on the basis of that Indian Standard.

5.2.3 *Feeding Farm Animals* — Feeding spent wash yeast sludge and concentrated spent wash to animals is also practised on a limited scale.

5.3 Biological Treatment — Distillery wastes are amenable to biological treatment, both anaerobic and aerobic. Since distillery wastes are of high biochemical oxygen demand, normally anaerobic treatment (predigestion) precedes any aerobic biological treatment.

5.3.1 *Anaerobic Processes* — The anaerobic treatment of distillery wastes can be either anaerobic digestion or anaerobic lagooning.

---

*Tolerance limits for industrial effluents discharged on land for irrigation purposes.

5.3.1.1 *Anaerobic digestion* — Anaerobic digestion of the raw waste has been found by various workers to be an excellent method of reducing about 90 percent of the biochemical oxygen demand of distillery waste, and a burnable gas containing high percentage of methane is also recovered as a by-product from this process. The performance of anaerobic digestion has been studied by Buswell and Le Bosquet[15], Stander[16], Parthasarathy *et al*[17], Davidson and Brown[18], Painter[19], Sen and Bhaskaran[20], and Radhakrishnan *et al*[21] and is presented in Table 3.

TABLE 3 ANAEROBIC TREATMENT OF DISTILLERY WASTES

SL No.	TREATMENT DETAILS	INFLUENT BOD, mg/l	BOD REMOVAL EFFICIENCY, percent	BOD LOADING kg/m³/day (lb/ft³/day)	DETENTION TIME, day	REFERENCE No. IN APPENDIX A
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	A. *Field Units*					
i)	Anaerobic digester	17 000	69·8	1·83 (0·114)	10	15
ii)	Anaerobic digester	16 000	90·0	2·29 (0·143)	14·4	15
iii)	Clari-digester	12 000	99·6	3·05 (0·19)	7·2	16
iv)	Anaerobic lagooning	40 000	95·0	—	66·0	22
	B. *Pilot Plants*					
v)	Undiluted waste	26 000 to 50 000	89·5	11·04 (0·688)	12·0	17
vi)	Undiluted waste	26 000 to 50 000	96·1	6·64 (0·414)	8·0	17
vii)	Evaporator condensate	600	85·0	0·96 (0·06)	15·0	18
viii)	Malt whisky distillery waste, undiluted	25 000	95·0	4·01 (0·25)	6·0	19
ix)	Molasses distillery	30 000	90·0	3·02 (0·188)	10·0	20

5.3.1.2 *Anaerobic lagooning* — Anaerobic lagooning is cheap and effective method of treatment of distillery wastes. Subbarao[22] reported 95 percent biochemical oxygen demand reduction in an anaerobic lagoon treating distillery wastes.

5.3.2 *Aerobic Processes* — The conventional aerobic biological processes, namely, trickling filters and activated sludge units have been adopted for treatment of distillery wastes. Extended aeration can also be adopted for treating these wastes.

5.3.2.1 *Trickling filters* — Trickling filters, single-stage or two-stage, are adopted for treating either diluted distillery waste or pretreated distillery waste as reported by Davidson[23], Schneider[24], Anderson and Sawyer[25], Gurnham[26], Hardwick and Roberts[27] and Painter[28] and results are presented in Table 4. Deep trickling filters made of plastics media are found to be useful in treating concentrated organic wastes including distillery wastes[29].

TABLE 4 TREATMENT OF DISTILLERY WASTES IN TRICKLING FILTERS

SL No.	DETAILS	INFLUENT BOD, mg/l	BOD REMOVAL EFFICIENCY, percent	BOD LOADING, kg/m³/day (lb/yd³/ day)	HYDRAULIC LOADING, l/ha/day (million gallons per acre/day)	REFERENCE No. IN APPENDIX A
(1)	(2)	(3)	(4)	(5)	(6)	(7)
	A. *Field Units*					
i)	Single stage (2 m deep)	600	91·8	0·45 (0·75)	88·0×10^6 (8·0)	23
ii)	Two stage (1 m deep each)	445	88·0	0·96 (1·6)	—	24
iii)	Two stage (1 percent spent wash +99 percent sewage)	485	95·0	0·96 (1·6)	—	25
iv)	Two stage	800	70-90	—	36·3×10^6 (3·3)	26
	B. *Pilot Plants*					
v)	Evaporator condensate of distillery (Recycle ratio 11 : 1)	240	39·6	0·66 (1·1)	330×10^6 (30·0)	27
vi)	Effluents of anaerobic digestion with BOD of 1250 mg/l with and without dilution	450 1250	91·0 84·0	0·16 (0·27) 0·45 (0·75)	5·5×10^6 (0·5) 5·5×10^6 (0·5)	28 28

5.3.2.2 *Activated sludge process* — The performance of activated sludge and extended aeration plants for treating diluted or pretreated distillery waste has been reported by Bhaskaran[7], Burkhead[30], and Panlette[31]. The data is presented in Table 5.

TABLE 5 ACTIVATED SLUDGE FOR DISTILLERY WASTES

(*Clause* 5.3.2.2)

SL No.	DETAILS	INFLUENT BOD, mg/l	BOD REMOVAL EFFICIENCY, percent	LOADING, kg/1000 m^3/day (lb/1000 ft^3/ day)	DETENTION TIME, hours	REFERENCE No. IN APPENDIX A
(1)	(2)	(3)	(4)	(5)	(6)	(7)
i)	Predigested distillery waste treated in activated sludge	1000 to 1200	91 to 94	—	6 to 8	7
ii)	Extended aeration pilot plant	314 to 564	77 to 97	48 to 432 (3 to 27)	—	30
iii)	Laboratory work	700	90·0 to 95·0	—	6 to 24	31

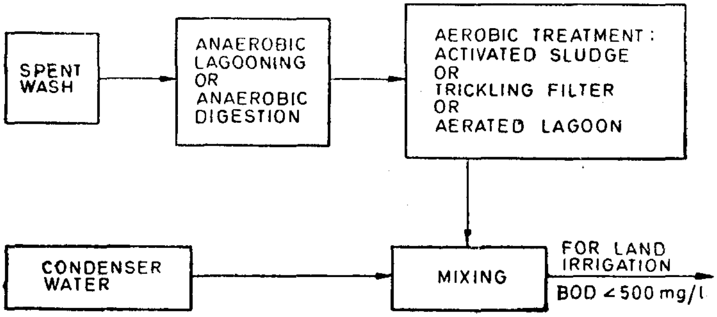
6. METHODS RECOMMENDED FOR ADOPTION IN INDIA

6.1 Byproduct Recovery

6.1.1 *Potash Recovery*

6.1.2 *Vitamin B_{12} Recovery*

6.2 Land Disposal — The spent wash may be treated by an anaerobic process such as anaerobic digestion or anaerobic lagooning followed by an aerobic process such as activated sludge process, trickling filtration, or aerated lagooning and the treated effluent diluted to have a biochemical oxygen demand of less than 500 mg/l and used for irrigation or disposed of on land (*see* Fig. 2).



SPENT WASH
ANAEROBIC LAGOONING OR ANAEROBIC DIGESTION
AEROBIC TREATMENT : ACTIVATED SLUDGE OR TRICKLING FILTER OR AERATED LAGOON
CONDENSER WATER
MIXING
FOR LAND IRRIGATION
BOD < 500 mg/l

FIG. 2 FLOW SHEET FOR THE TREATMENT OF SPENT WASH FOR DISPOSAL ON LAND

6.3 Disposal to Water Course — The spent wash may be treated by anaerobic process followed by one of the aerobic processes, such as extended aeration, activated sludge process, trickling filtration or aerated lagooning and diluted with condenser waters to keep the BOD of the final effluent below 100 mg/l before disposing of into a water course (*see* Fig. 3). It may be necessary to dilute the influent to the aerobic processes. This can be done by using part of the condenser water.

6.3.1 If suspended solids in the spent wash are high then it is useful to separate them, dry and incinerate them or dispose of on land. The settled spent wash can then to be taken for biological treatment.

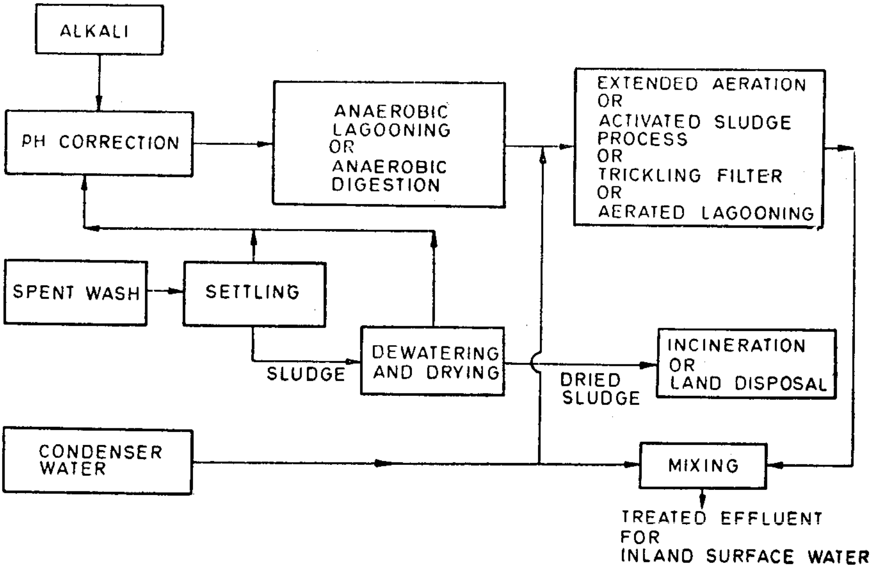

ALKALI
PH CORRECTION
ANAEROBIC LAGOONING OR ANAEROBIC DIGESTION
EXTENDED AERATION OR ACTIVATED SLUDGE PROCESS OR TRICKLING FILTER OR AERATED LAGOONING
SPENT WASH
SETTLING
SLUDGE
DEWATERING AND DRYING
DRIED SLUDGE
INCINERATION OR LAND DISPOSAL
CONDENSER WATER
MIXING
TREATED EFFLUENT FOR INLAND SURFACE WATER

FIG. 3 FLOW SHEET FOR THE TREATMENT OF SPENT WASH FOR DISPOSAL INTO INLAND SURFACE WATER

APPENDIX A

(*Clause* 0.3)

REFERENCES

1) CHAKRABARTY (R N). Potash recovery. A method of disposal of distillery wastes and saving foreign exchange. *Chem Age Ind.* 15; 1964; 93-96.

2) INDIA. NATIONAL ENVIRONMENTAL ENGINEERING RESEARCH INSTITUTE. Internal report, 1970-71.

3) BENERENFEIND (J C) *et al. Industr Engin Chem.* 36; 1944; 76.

4) SLACK (S T) *et al.* Value of distillers' feeds for dairy calves. 1957. New York State College of Agriculture, Ithaca.

5) USA. DISTILLERS FEED RESEARCH COUNCIL. Make more milk with distillers' feed and feed formulation with distillers' feed.

6) BORUFF (C S). Fermentation industries; industrial wastes, their disposal and treatment. 1952. Reinhold Publishing Corporation, New York.

7) BHASKARAN (T R). Report of work done by the Public Health Research Unit. 1962. All India Institute of Hygiene and Public Health, Calcutta. (Unpublished).

8) SHREVE (R N). Potassium salts and mixed fertilizers. 1956. McGraw-Hill Book Co, New York.

9) JACKSON (C J). Whisky and industrial alcohol distillery. *J proc Inst Sewage Purif.* Part 3; 1956; 207.

10) REICH (G T). Production of carbon and potash from molasses distillers stillage. *Amer Inst Chem Engin.* 41; 1945; 233.

11) WHITAKER (M C). US Patent. 1492; 656.

12) CHAKRABARTY (R N) and BHASKARAN (T R). Utilisation of liquid wastes from molasses distillery for recovery of potassium salts. (Special Report of the Indian Council of Medical Research). Indian Council of Medical Research, New Delhi.

13) GHOSH (T K) *et al.* Biochemical utilisation of distillery spent liquor. *J Instn Engin (Ind).* 42; 1962; 6; Part CH-2.

14) RASTOGI (M K) and AGARWAL (S C). Patent No. 65283; 1959.

15) BUSWELL (A M) and LE BOSQUET (M). *Industr Engin Chem.* 28; 1938; 38.

16) STANDER (C J). Treatment of wine distillery wastes by anaerobic digestion. *Forming Part of* Proceedings of Twenty Second Industrial Wastes Conference, Purdue University, Lafayette (Indiana), USA. 1967. P 892.

17) PARTHASARATHY (T) *et al.* Anaerobic stabilization of distillery wastes from cane sugar industry. *Environ health.* 9; 1967; 110.

18) Davidson (B) and Brown (H B). Rapid anaerobic digestion studies. *Forming Part of* Proceedings of Seventh Industrial Wastes Conference, Purdue University, Lafayette (Indiana), USA. 1952.

19) Painter (H A). Treatment of malt whisky distillery wastes by anaerobic digestion. ***Brewers guardian.*** August 1960.

20) Sen (B P) and Bhaskaran (T R). Anaerobic digestion of liquid molasses distillery wastes. *J Water Pollution Control Fed.* October 1972.

21) Radhakrishnan (I) *et al.* Evaluation of the loading parameters for anaerobic digestion of cane molasses distillery wastes. *J Water Pollution Control Fed.* November 1969.

22) Subbarao (B A). Technical report on sugar distillery industry waste disposal. 1971. Walchand College of Engineering, Sangli.

23) Davidson (A B). Designing a distillery waste disposal plant. *Forming Part of* Proceedings of Fifth Industrial Wastes Conference, Purdue University, Lafayette (Indiana), USA. 1949.

24) Schneider (R). *Sewage and industr wastes.* 22; 1950; 1307.

25) Anderson (E J) and Sawyer (C N). *Water sewage works.* 96; 112; 1949.

26) Gurnham (C F). Principles of industrial wastes treatment. 1955. John Wiley & Sons, New York.

27) Hardwick (J B) and Roberts (N). High rate trickling filter pilot plant studies on distillery wastes. *Forming Part of* Proceedings of Sixth Industrial Wastes Conference, Purdue University, Lafayette (Indiana), USA. 1951.

28) Painter (H A). Treatment of malt whisky distillery wastes by anaerobic digestion. ***Brewers' guardian.*** August 1960.

29) Chipperfield (P N J). Performance of plastic filter media in industrial and domestic waste treatment. *J Water Pollution Control Fed.* 39; 1967; 1860.

30) Burkhead (C E). Biological treatment of a distillery waste. *Forming Part of* Proceedings of Twenty Third Industrial Wastes Conference, Purdue University, Lafayette (Indiana), USA. 1968. P 520.

31) Panlette (R G). Pollution abatement programme for distillery waste. ***J Water Pollution Control Fed.*** 42; 1970; 1397.

(*Continued from page* 2)

Members	*Representing*
SHRI R. N. GHATAK	Indian Yeast Co Ltd, Bombay
SHRI A. MAJUMDAR (*Alternate*)	
SHRI M. R. G. MENON	Indian Sugar Mills Association, Calcutta
SHRI B. MUKERJEE	All India Distillers' Association, New Delhi
SHRI M. R. G. MENON (*Alternate*)	
DR G. N. RADHAKRISHNA	Visvesvaraya College of Engineering, Bangalore
DR T. N. RAMACHANDRA RAO	Central Food Technological Research Institute (CSIR), Mysore
SHRI M. S. SUBHA RAO (*Alternate*)	
DR D. S. SARASWAT	Glaxo Laboratories (India) Ltd, Bombay
SHRI S. M. KHAN (*Alternate*)	
SHRI M. V. SRINIVASAN	National Environmental Engineering Research Institute (CSIR), Nagpur
DR M. G. VAIDYA	Hindustan Antibiotics Ltd, Pune
DR P. S. BORKAR (*Alternate*)	

BUREAU OF INDIAN STANDARDS

***Headquarters*:**
Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002
Telephones: 323 0131, 323 3375, 323 9402
Fax : 91 11 3234062, 91 11 3239399, 91 11 3239382

Telegrams : Manaksanstha
(Common to all Offices)

***Central Laboratory*:**	*Telephone*
Plot No. 20/9, Site IV, Sahibabad Industrial Area, Sahibabad 201010	8-77 00 32
Regional Offices:	
Central : Manak Bhavan, 9 Bahadur Shah Zafar Marg, NEW DELHI 110002	323 76 17
*Eastern : 1/14 CIT Scheme VII M, V.I.P. Road, Maniktola, CALCUTTA 700054	337 86 62
Northern : SCO 335-336, Sector 34-A, CHANDIGARH 160022	60 38 43
Southern : C.I.T. Campus, IV Cross Road, CHENNAI 600113	235 23 15
†Western : Manakalaya, E9, Behind Marol Telephone Exchange, Andheri (East), MUMBAI 400093	832 92 95
Branch Offices::	
'Pushpak', Nurmohamed Shaikh Marg, Khanpur, AHMEDABAD 380001	550 13 48
‡Peenya Industrial Area, 1st Stage, Bangalore-Tumkur Road, BANGALORE 560058	839 49 55
Gangotri Complex, 5th Floor, Bhadbhada Road, T.T. Nagar, BHOPAL 462003	55 40 21
Plot No. 62-63, Unit VI, Ganga Nagar, BHUBANESHWAR 751001	40 36 27
Kalaikathir Buildings, 670 Avinashi Road, COIMBATORE 641037	21 01 41
Plot No. 43, Sector 16 A, Mathura Road, FARIDABAD 121001	8-28 88 01
Savitri Complex, 116 G.T. Road, GHAZIABAD 201001	8-71 19 96
53/5 Ward No.29, R.G. Barua Road, 5th By-lane, GUWAHATI 781003	54 11 37
5-8-56C, L.N. Gupta Marg, Nampally Station Road, HYDERABAD 500001	20 10 83
E-52, Chitaranjan Marg, C-Scheme, JAIPUR 302001	37 29 25
117/418 B, Sarvodaya Nagar, KANPUR 208005	21 68 76
Seth Bhawan, 2nd Floor, Behind Leela Cinema, Naval Kishore Road, LUCKNOW 226001	23 89 23
NIT BUilding, Second Floor, Gokulpat Market, NAGPUR 440010	52 51 71
Patliputra Industrial Estate, PATNA 800013	26 23 05
Institution of Engineers (India) Building 1332 Shivaji Nagar, PUNE 411005	32 36 35
T.C. No. 14/1421, University P. O. Palayam, THIRUVANANTHAPURAM 695034	6 21 17

---

*Sales Office is at 5 Chowringhee Approach, P.O. Princep Street, CALCUTTA 700072	27 10 85
†Sales Office is at Novelty Chambers, Grant Road, MUMBAI 400007	309 65 28
‡Sales Office is at 'F' Block, Unity Building, Narashimaraja Square, BANGALORE 560002	222 39 71

Printed at Printograph, New Delhi, Ph : 5726847